WHY DIDN'T THE PAVEMENT DISTRESS QUALITY ASSURANCE PLAN WORK?

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Presentation for RPUG 2017

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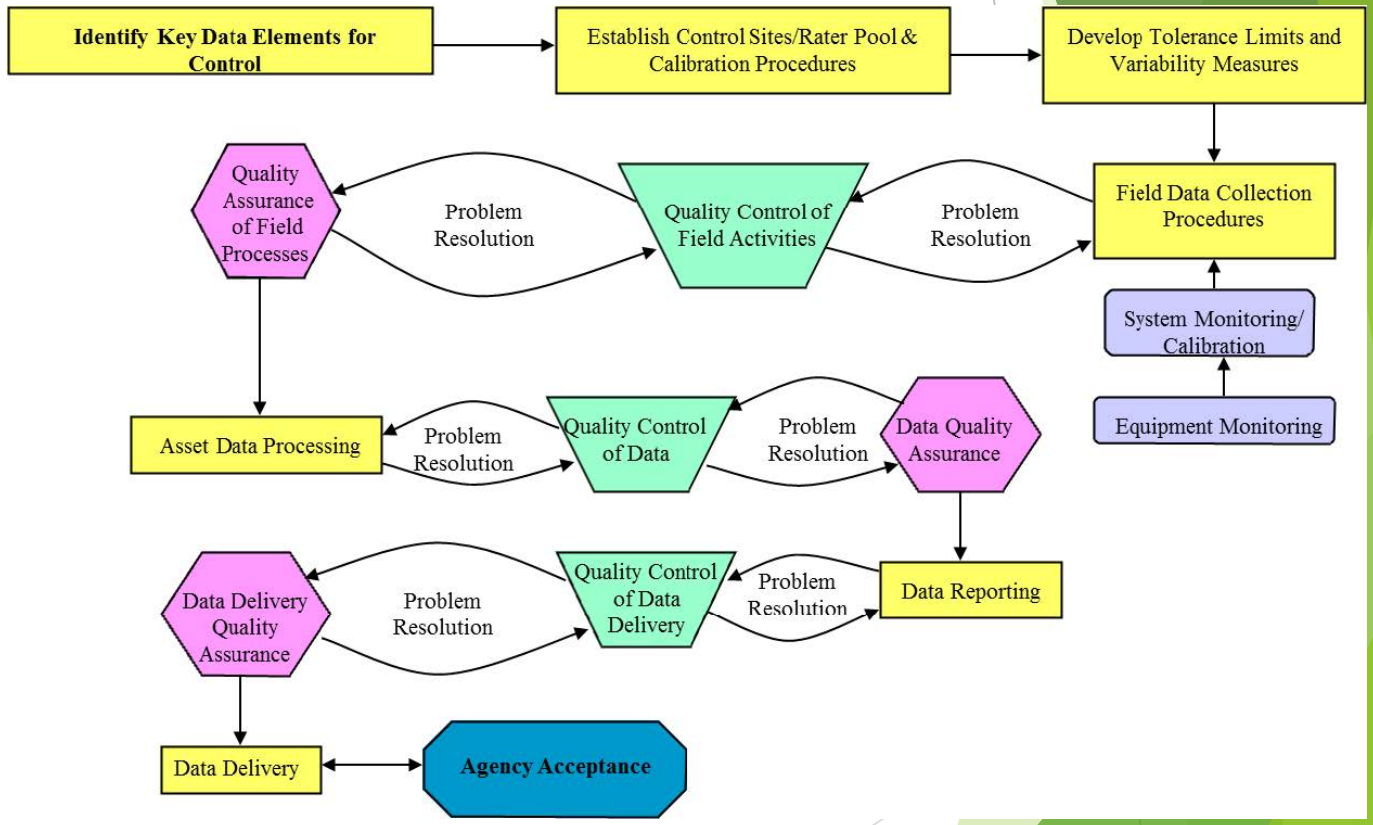
KEY STEPS IN DATA QUALITY MANAGEMENT

1. Identify key data elements for control
2. Identify sources and range of variability
3. Define control items and limits
4. Control site evaluations
5. Levels of control
6. Production level quality assurance
7. Lessons learned



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BACKGROUND

- QES began quality monitoring in Virginia in 2005
- Developed a statically based plan to control distress rating
- Automated data collection (2D then 3D beginning in 2016)
- Historically collected:
  - All Interstate (~2,400 miles)
  - All Primary (~12,000 miles)
  - 20 – 25% of Secondary (~13,000 miles)
- In 2016, 100% of Secondary's were collected (~45,000 miles)

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BACKGROUND

- Deliverables submitted by route type and/or district
  - Interstates
  - Primary Districts 1-9
  - Secondary Districts 1-9
  - Other routes

DEFINE CONTROL ITEMS AND VALUES

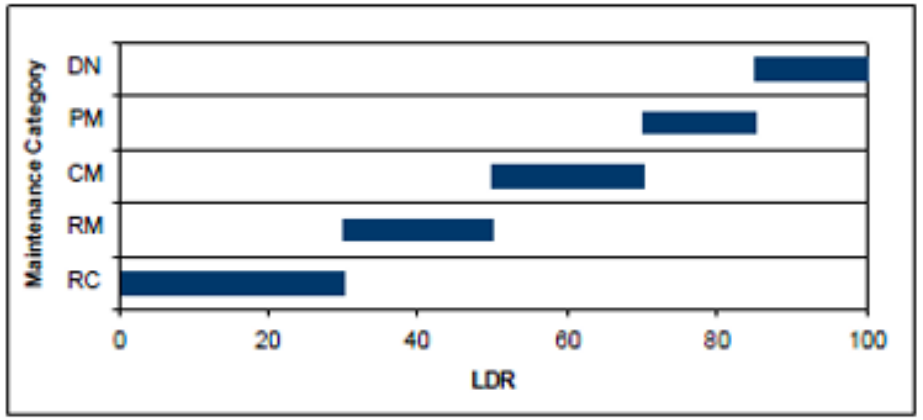
- Control the data that affects the pavement management decisions
  - Identification of the key data elements to be controlled
  - Determine the criticality of each element and expected variability
  - Establish control data
  - Develop tolerance limits and variability measures
- Practical
- Statistically based
- Distress
  - Individual distress types and/or severities
  - Index values
- Range and completeness checks

VDOT CONTROLS

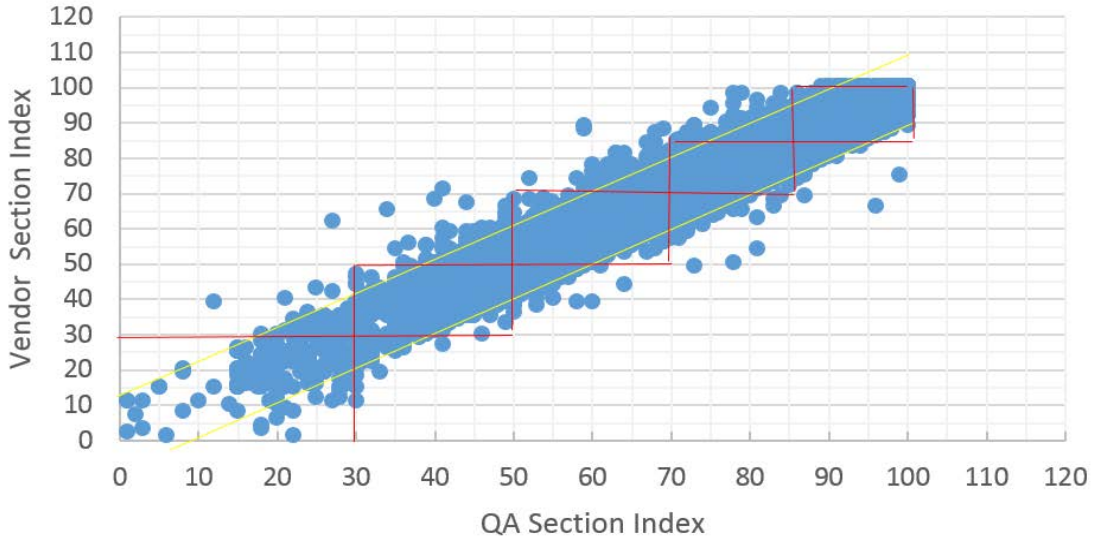
- Control is based on index values
  - Load Related Distress Index (LDR), 0-100
  - Non-Load Related Distress Index (NDR), 0-100
  - Critical Condition Index (CCI), 0-100
- Control limits are 10 points
- 95% of all QA samples must be within limits for an acceptable deliverable

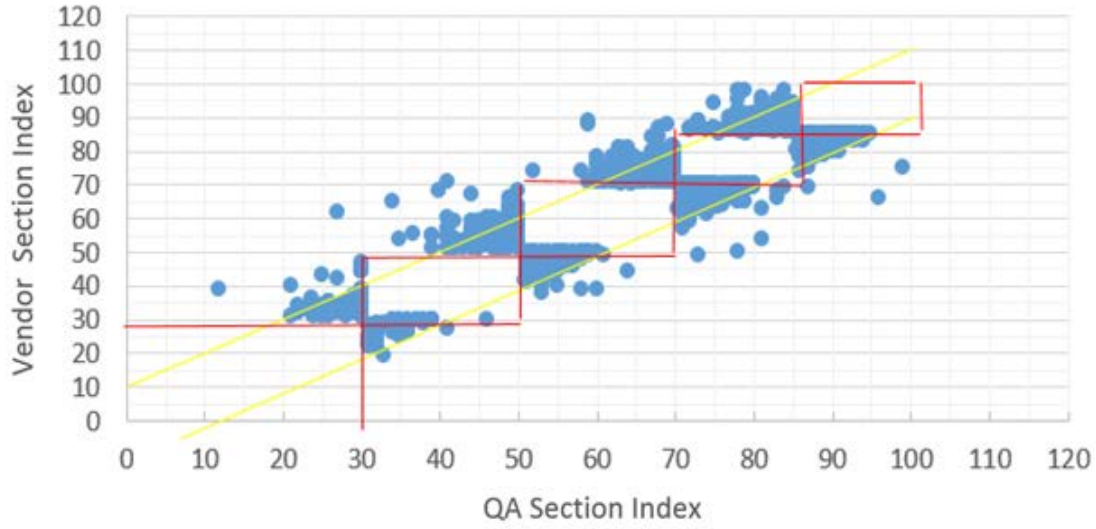
Recommended Exclusive Ranges for BIT Pavement

Maintenance Category	LDR Index		NDR Index	
	Max	Min	Max	Min
RC	30	0	30	0
RM	50	> 30	50	> 30
CM	70	> 50	70	> 50
PM	85	> 70	85	> 70
DN	100	> 85	100	> 85



LDR Variation for BIT Pavements – Recommended





Production Level Quality Assurance

- Control key data elements
- Independent distress evaluations
- High level data range checks
  - Quantities do not exceed section limits or reasonable boundaries
- Year-to-year consistency checks
  - Pavement does not improve without reason
  - Pavement does not deteriorate at unreasonable rate
  - Can be affected by time of year and/or weather

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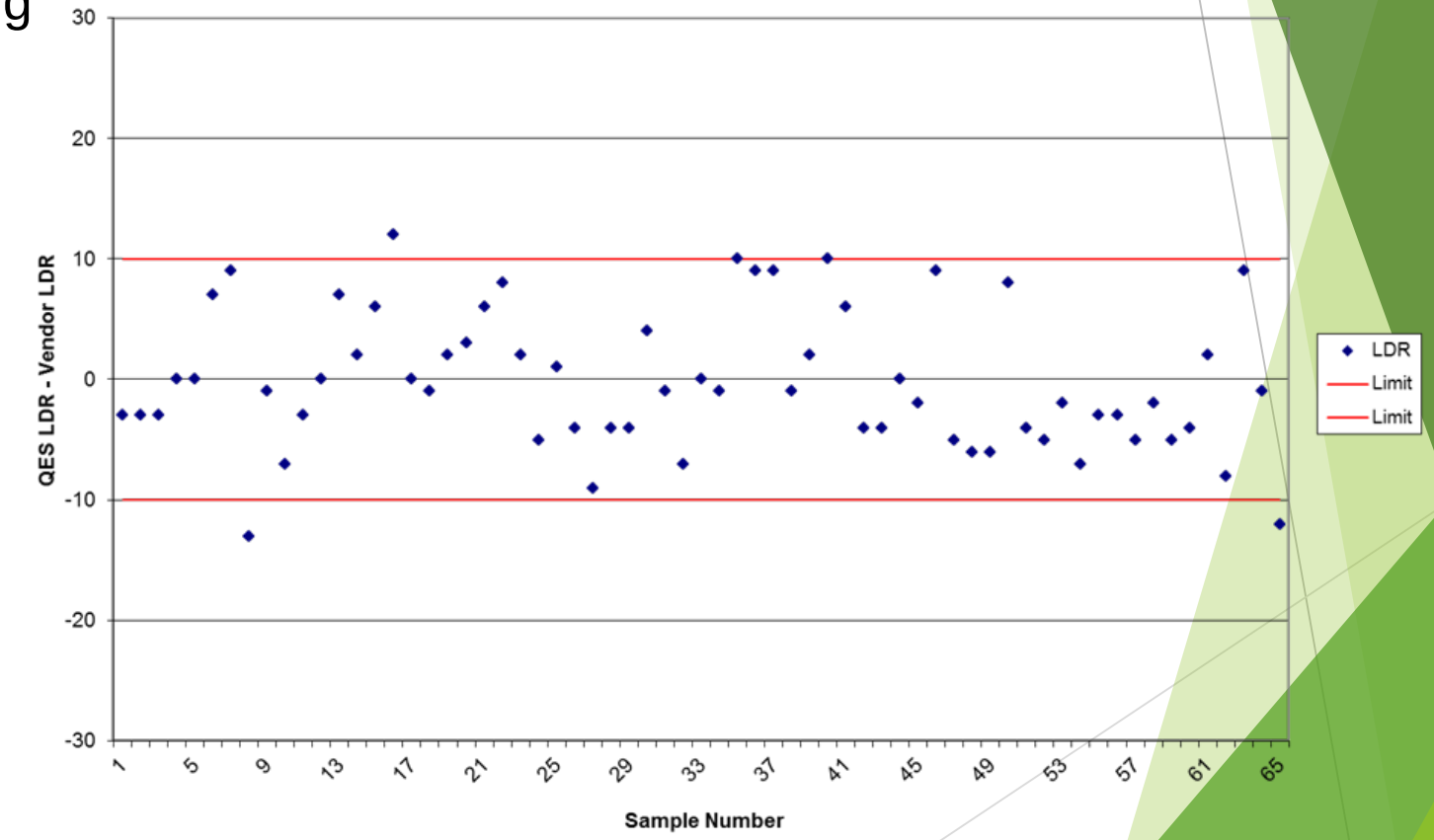
VDOT Process

- 5% random sample per deliverable
- Independent distress rating
  - Compare LDR & NDR Index Values
    - Within 10 index points for 95% of the samples



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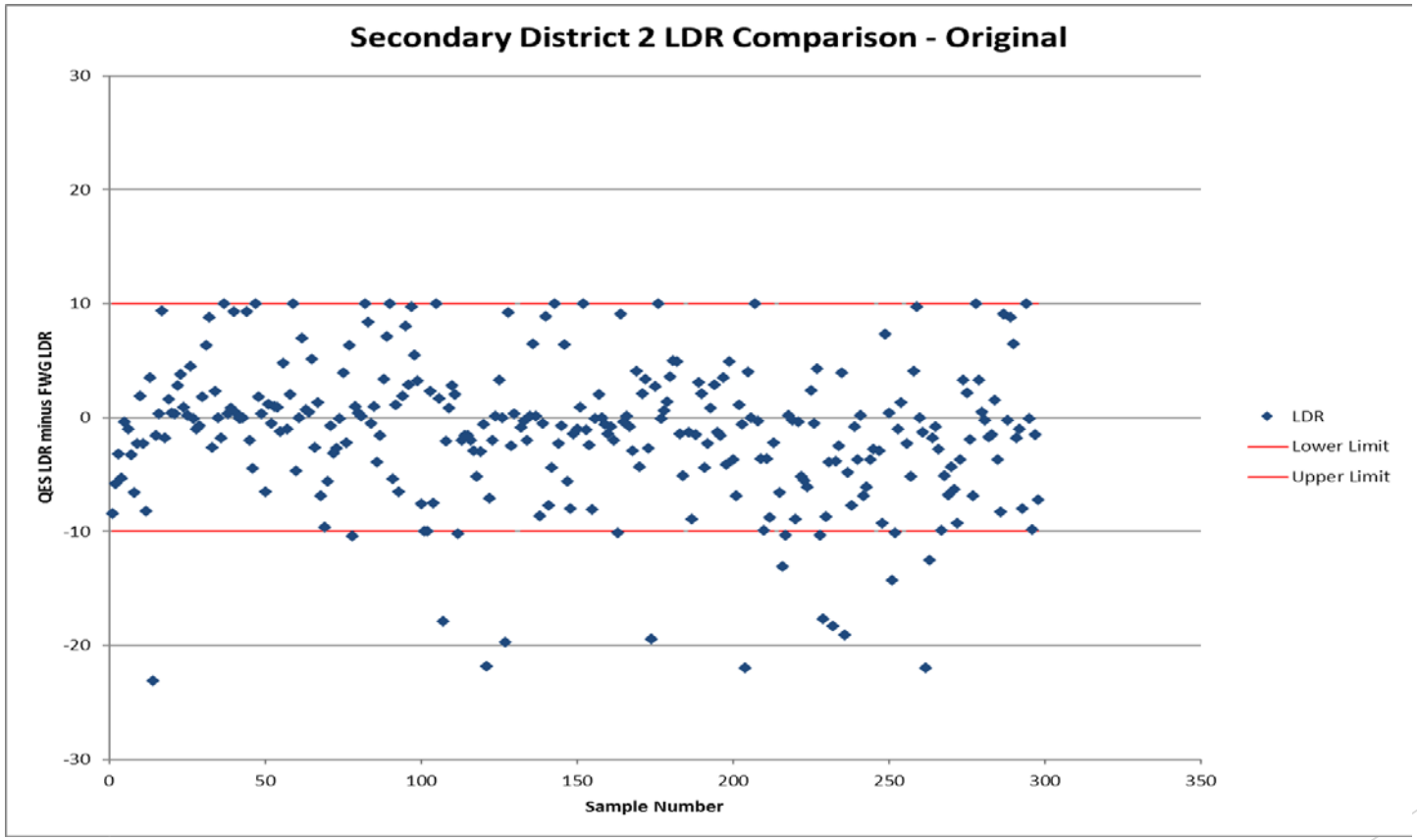
2016 Secondary District 2 LDR

- 5% random sample per deliverable (292 samples)
- 95.5% passing LDR Check



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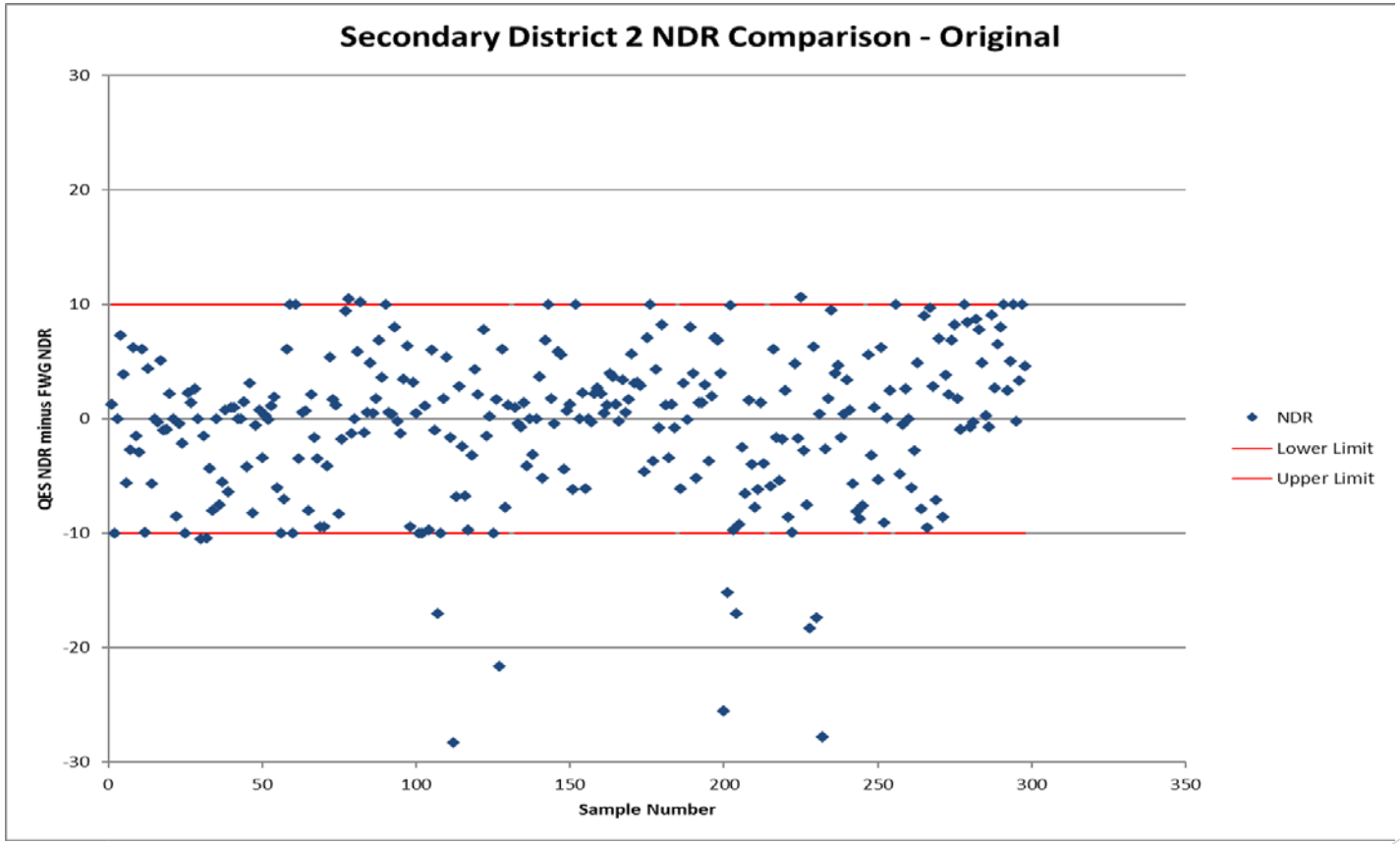
2016 Secondary District 2 NDR

- 5% random sample per deliverable (292 samples)
- 96.2% passing NDR Check



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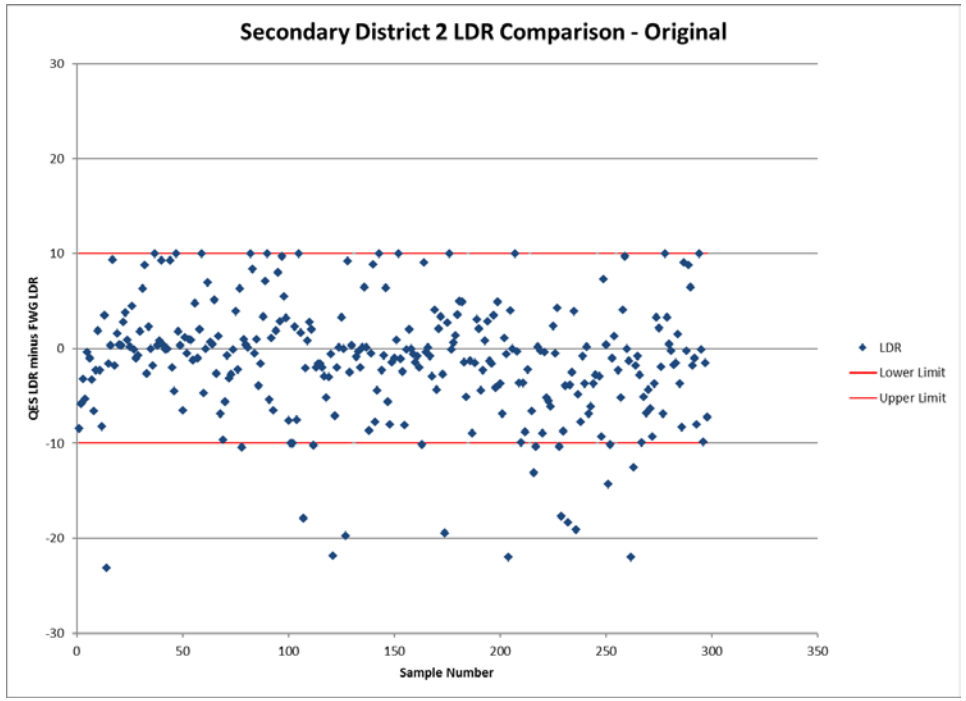
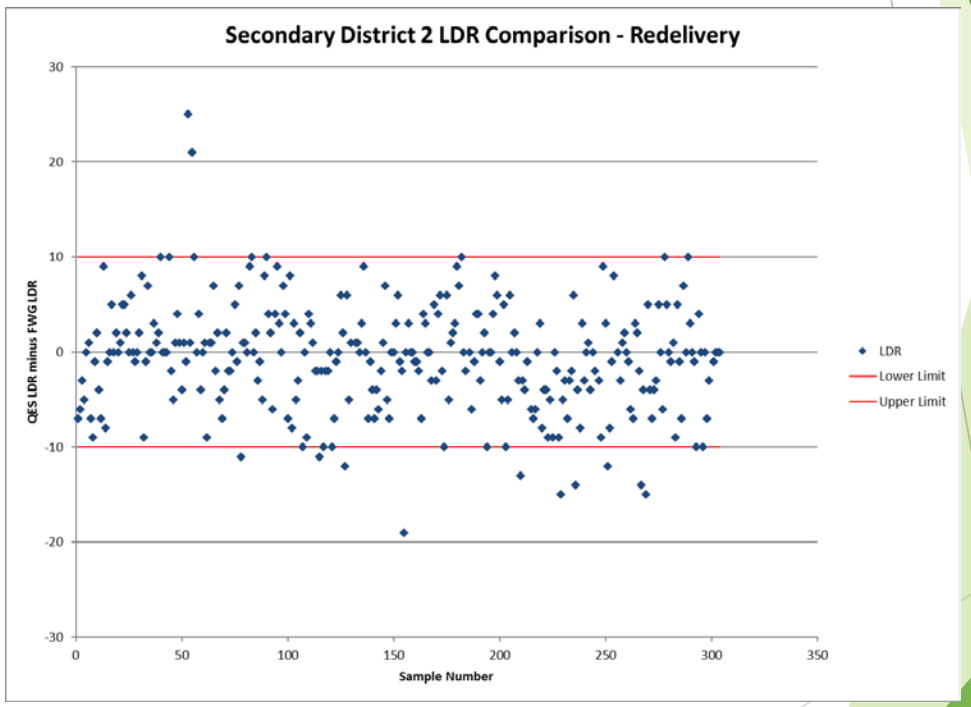
ISSUES?

- Data appeared to have passed both LDR & NDR checks
- When Year-to-Year comparisons were made with 2015 data, something was wrong
- Much less longitudinal and transverse cracking and level 1 alligator cracking was reported on average than previous year
- Vendor determined a setting was missed during a processing step, so much of the cracking was not being reported
- WHY DID THE SAMPLE CHECKS PASS THE COMPARISON?

2016 Secondary District 2 LDR REDELIVERY



95.5%



96.0%

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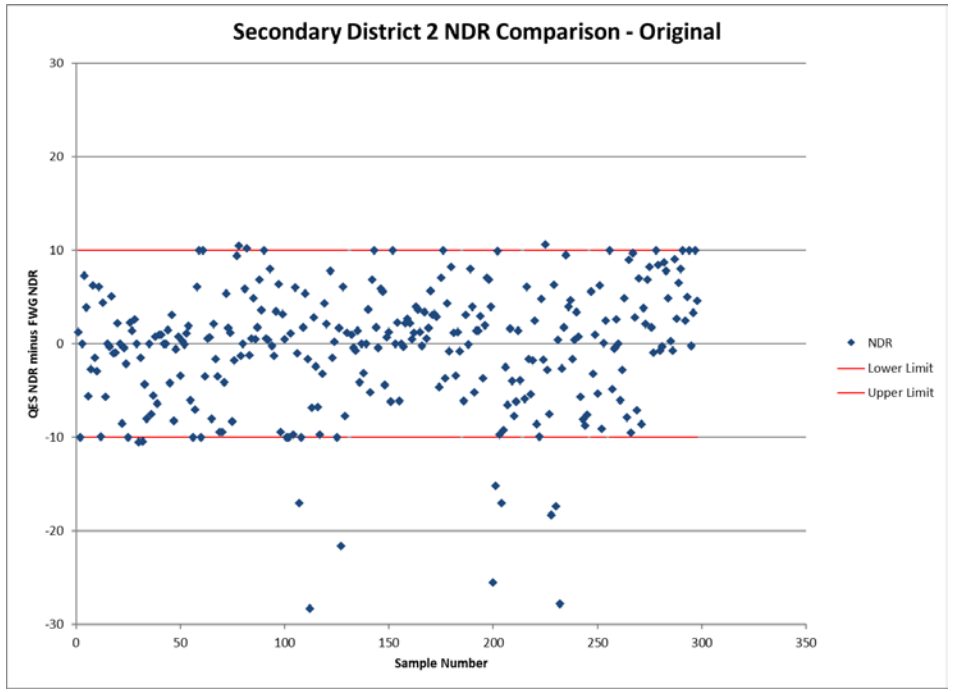
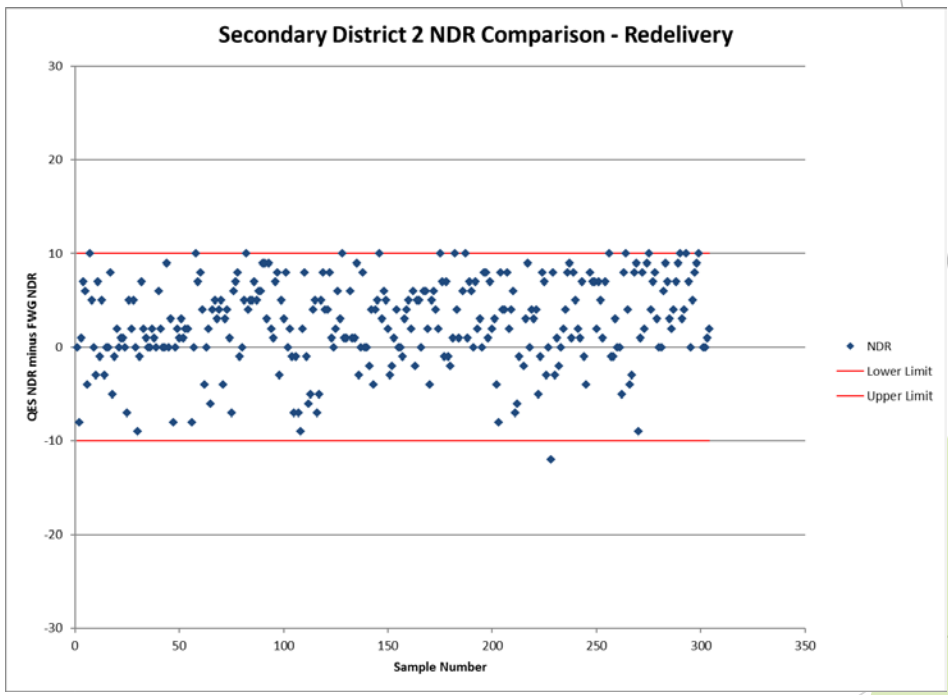
2016 Secondary District 2 NDR REDELIVERY



96.2%



99.3%

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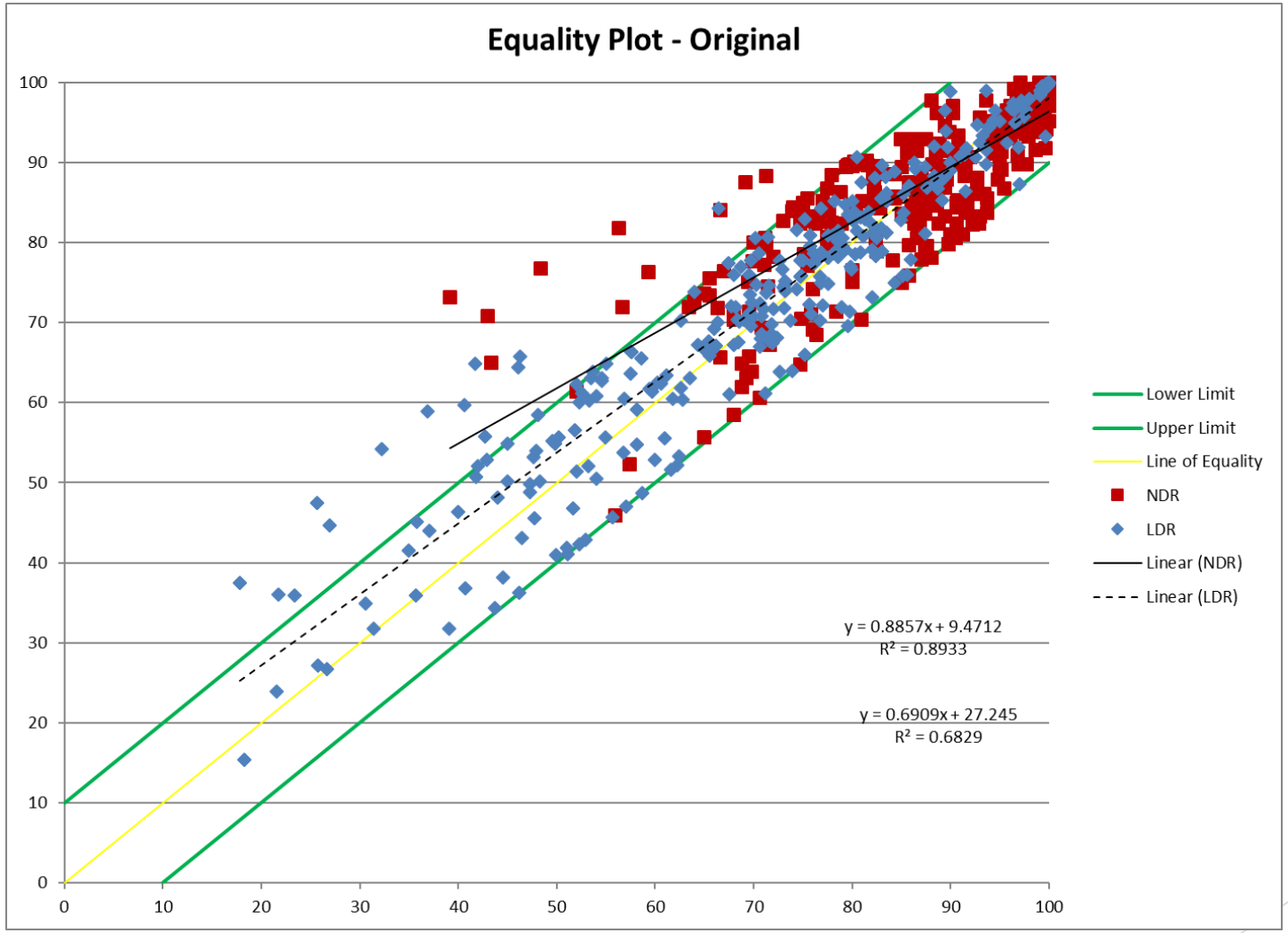
POSSIBLE REASONS/SOLUTIONS

- QES independent ratings were processed with the same missing setting
  - Modify the processing steps to allow QES to process our own ratings
- Incorrect Limits
  - Consider adjustable limits, more distress = more variability?
  - Original limits developed based upon rater pool and D2S limits
  - Different means to define limits (COV, Quartile, Tukey Limits)
- Outlier analysis (Theta Parameter)
- Categorical Bias
- Stratified Sampling

CATEGORICAL BIAS (EQUALITY CHART)



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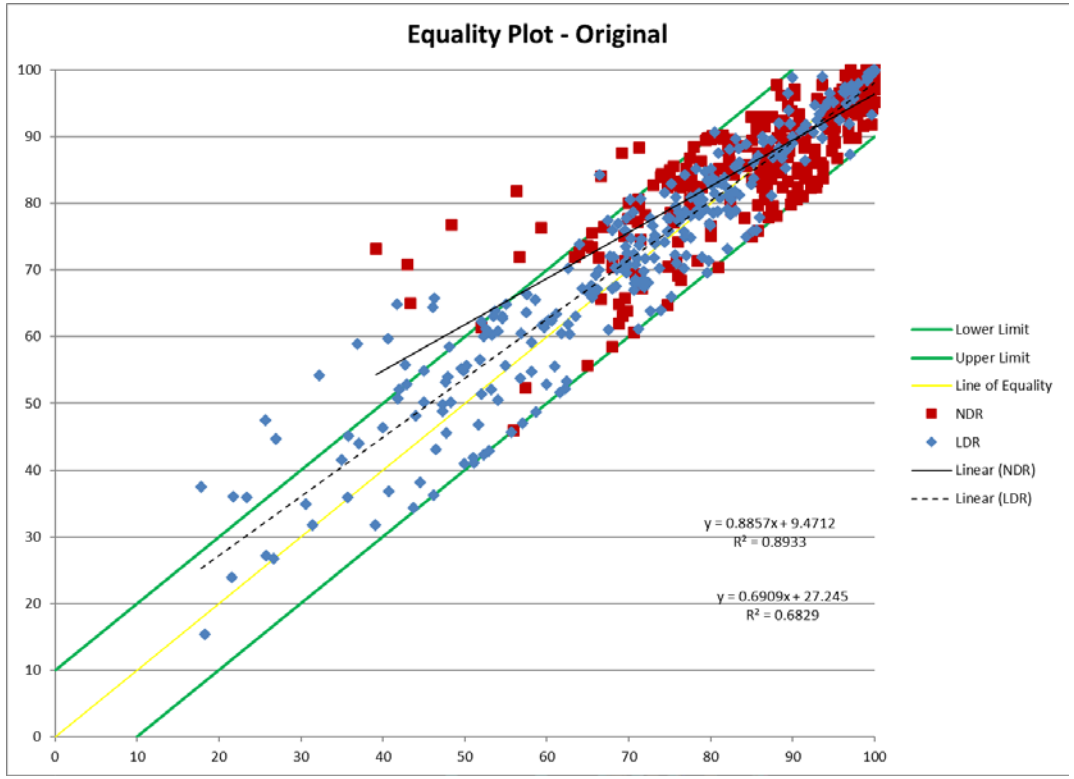
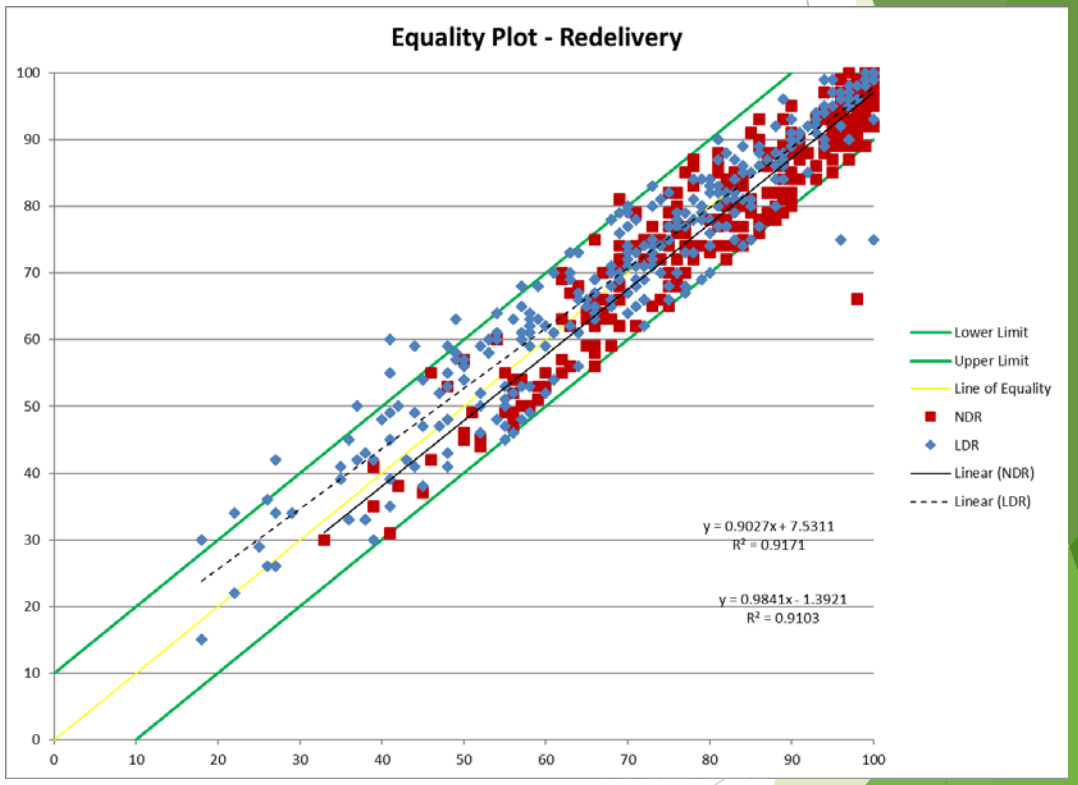
2016 CATEGORICAL BIAS (EQUIVALENCY CHART)





Slope of trend line should be 0.85 to 1.15

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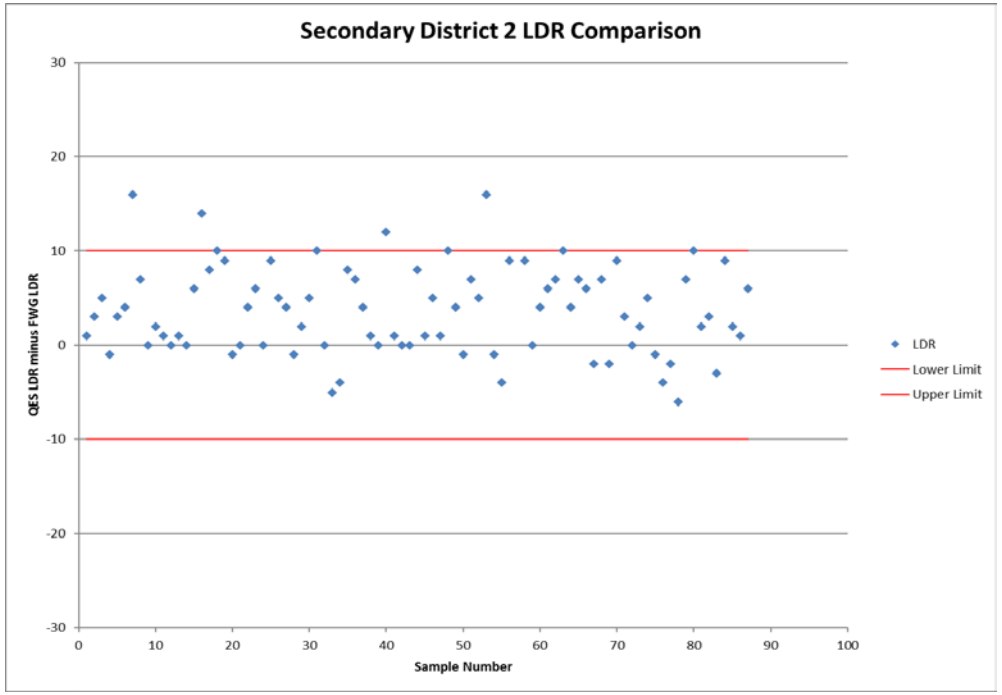
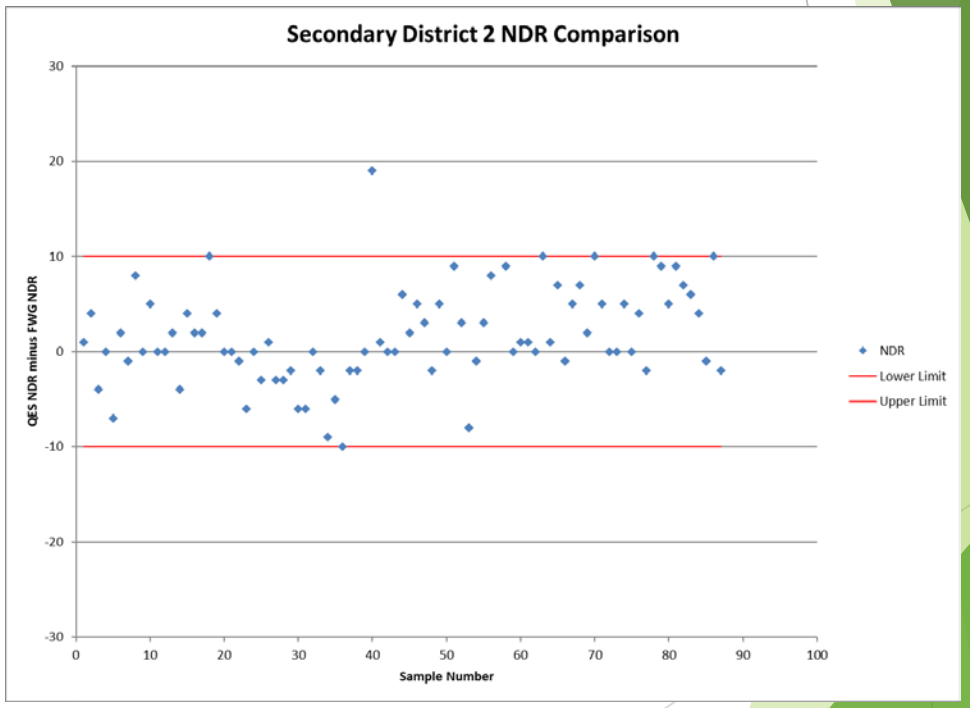
2017 Secondary District 2 LDR

- 5% random sample per deliverable (86 samples)
- 95.3% passing LDR Check, 98.8% passing NDR





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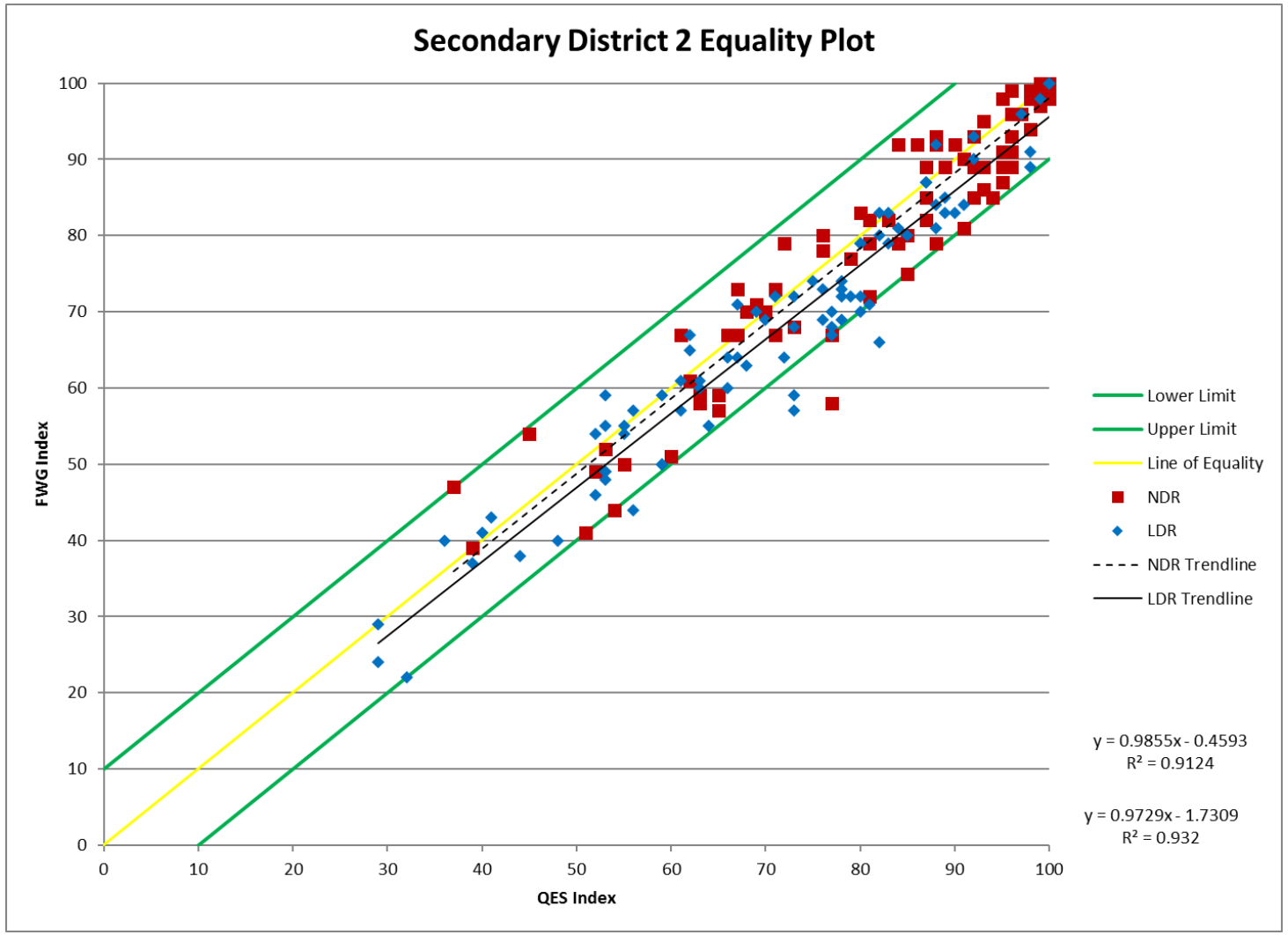
2017 Secondary District 2



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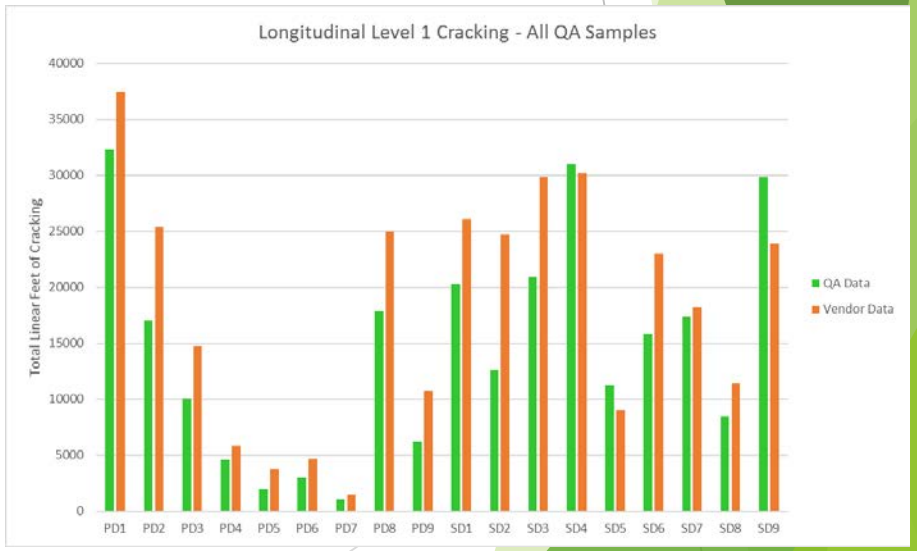
PROCESS IMPROVEMENTS

- Implemented the Categorical Bias Plot
  - Allowable slope is between 0.85 and 1.15
- Perform an outlier analysis (Theta Parameter)
- Addition of Stratified Sampling
  - Increase sampling in the CCI range of 45 to 80 based on previous years data
- Enhanced Year-to-Year checks
  - Summarize total distress reported for all samples for Vendor and QA team and compare
  - Look at multi-year trends in index values and individual distresses
- Allow QES to process our own ratings



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SUMMARY

- Consider dividing large deliveries
- Sample size is important
- Continually look for ways to improve the quality monitoring process
- Be willing to make adjustments

THANK YOU!

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